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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	
Rainer HÖCKER et al.	Group Art Unit: 3743
Application No.: 10/002,633	Examiner: L. Leo
Filed: December 5, 2001	Confirmation No.: 4154
For: WALL PART ACTED UPON BY AN IMPINGEMENT FLOW	

BRIEF ON APPEAL

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I. INTRODUCTION

A. Real Party in Interest

The real party in interest with respect to this appeal is Alstom, Ltd., the named assignee in this application.

B. Related Appeals and Interferences

There are no interferences or other appeals known to the Appellants, the Appellants' legal representative, or the assignee, which will directly affect or be directly affected by or have a bearing on the Board's decision in this pending appeal.

C. Status of Claims

This application was originally filed on September 18, 1998 with six claims--Independent Claim 1 and dependent Claims 2-6.

On September 15, 1999, a first Office Action issued. Responsive to the first Official Action in this application, Applicants canceled Claims 3 and 4 and amended Claims 1, 2, 5, and 6. On February 29, 2000, a final Official Action was issued. A response was filed on July 24, 2000, setting forth further amendments to Claim 1. On July 31, 2000, an Advisory Action issued. On August 29, 2000, a continuation prosecution application was filed, together with a Preliminary Amendment setting forth amendments to Claim 1 and adding new Claim 7. On November 20, 2000, an Official Action issued, rejecting Claims 1, 2, and 5-7. In an Amendment dated March 20, 2001, new Claim 7 was canceled. On June 5, 2001, a final Official Action issued, and a Request for Reconsideration was filed on

November 3, 2001. An Advisory Action issued on November 8, 2001. On December 5, 2001, a Continuation application was filed. On January 29, 2002, an Interview was conducted. On February 1, 2002, a Preliminary Amendment was filed. On September 18, 2002, an Official Action issued. On December 12, 2002, further amendments were made to Claims 1, 2, and 6. On February 25, 2003, a final Official Action issued. On June 25, 2003, a Response was filed. On July 8, 2003, an Advisory Action issued. On July 24, 2003, Applicants filed a Notice of Appeal. Hence, Claims 1, 2, 5, and 6 are currently pending in this application.

Pursuant to 37 C.F.R. § 1.191(a), Applicants hereby appeal the Examiner's decision finally rejecting Claims 1, 2, 5, and 6 to the Board of Patent Appeals and Interferences.

D. Status of Amendments

No amendments to the claims were submitted after the final Office Action of February 25, 2003.

A copy of the claim at issue on appeal is attached as Appendix A.

II. SUMMARY OF THE INVENTION [1]

With reference to FIG. 1, a disclosed embodiment of the present invention pertains to an impingement flow for a wall part 3, in which a plurality of impingement orifices 2 are arranged areally in a plane or curved carrier 1. The carrier 1 is arranged at a distance from

[1] This summary is provided in accordance with 37 C.F.R. § 1.192(5) and Section 1206 of the Manual of Patent Examining and Procedure, and is not intended to limit the subject matter of the claimed invention to the specific embodiment described herein.

the wall part 3. The impingement area of the wall part 3 is designed as a relief, and is provided with a number of troughs 4 arranged next to one another so that one impingement jet is provided per trough 4. That is, each trough 4 is arranged opposite an impingement orifice 2. The troughs 4 are in the form of spherical cups or similar rotationally symmetrical forms. Thus, every impingement jet is discharged into a separate trough 4, and strikes a trough base at least approximately perpendicular. The side of the wall part which is remote from the impingement jet is of at least roughly plane design.

Because of this arrangement, the impinging jets are deflected and flow along the surface of the trough towards the free space between the carrier and wall. The trough surface is the area of the highest heat transfer, but also the area of the minimum influence of cross flow of spent cooling medium against the impingement jets. In this way, the negative influence of cross flow is minimized. As such, a main advantage of the present invention is increased effectiveness of impingement flow, because the cooling air can flow off without disturbing adjacent impingement jets. In addition, the heat-transmitting surface of the wall is increased.

III. THE REJECTIONS, REFERENCES AND EXAMINER'S POSITION

A. The Rejections

Claims 1 and 5-6 were rejected under 35 U.S.C. § 102(b) as being anticipated by GB 849,255 to *Cermak*.

Claims 1, 2, 5, and 6 were rejected under 35 U.S.C. § 103(a) as being obvious over *Cermak* in view of U.S. Patent No. 5,365,400 to *Ashiwake et al.*

Claims 1-2 and 5-6 were rejected under 35 U.S.C. §103(a) as being obvious over the NASA Publication to *Livingood et al.* in view of U.S. Patent No. 5,586,866 to *Wettstein*.

B. The References

i. GB 849,255 to Cermak

GB 849,255 to *Cermak* discloses a method and arrangement for cooling the walls of combustion spaces and other spaces subject to high thermal stresses. With reference to Fig. 2, a wall 1 defines a combustion space. The wall 1 includes cylindrical pockets 7. Coolant flows through an inlet channel 2 through a distribution channel 4 to nozzles 5. Nozzles 5 protrude into cooling pockets 7. The cooling medium 7 flows from the cooling pocket 7 immediately into the collecting chamber 6, from where it is withdrawn through the outlet 3 for further use. See page 2, lines 70-126.

ii. U.S. Patent No. 5,365,400 to Ashiwake et al.

U.S. Patent No. 5,365,400 to *Ashiwake et al.* relates to heat sinks and a semiconductor cooling device using the heat sinks. With reference to FIG. 8, a plurality of tabular fins 2 formed with through-holes 1 cooperate to form an axis-directional path 5 for leading a cooling fluid 4 to the central part of the heat sink 5. A fin 8 constituting a bottom plate of the heat sink is bored with no through-hole and serves to blockade the axis-directional path 5. The tabular fins are laminated to form passageways 7 for flowing the cooling fluids 6 in radial directions. See column 6, lines 33-48.

With reference to column 7, beginning at line 62, the tabular fins are formed to have curvatures to assume a spherical surface. This configuration causes centrifugal forces to act on the radial flows, with the result that vertical vortices are produced, as shown in FIG. 9.

iii. NASA Publication to Livingood et al.

Impingement cooling is known to be a very effective method of cooling in a wide variety of technical processes, such as blade or vane cooling in gas turbines. *Livingood et al.* is one of a plurality of studies in this field investigating the heat transfer parameters of impingement jets onto plane surfaces or surfaces having a curvature.

Livingood et al. discloses an experimental arrangement for studying the heat transfer characteristics of a *single* turbulent air jet impinging on the concave surface of a hemispherical shell. The Examiner concedes that it comprises a single shell with a constant wall thickness (see Figure 1, section A-A).

The parameters selected in the *Livingood et al.* study reflect the real facts in the area of the leading edge. A constant wall thickness is a characteristic feature of the shell of *Livingood et al.* and a constant or near constant wall thickness is the characteristic feature of the leading edge of a vane or blade. Therefore, *Livingood et al.* clearly refers to impingement cooling of concave walls, characterized by constant thickness in all areas of the concavity.

There is only a single concavity opposed to the region of the leading edge of a blade or vane. Moreover, there is no opposed planar surface in this region. Inside of the blade of the leading edge is formed a semicylinder, which longitudinally extends from the foot to

the tip of the blade. And the outer wall side is shaped either identically to the inner side or similarly with a thickening in the center. But in no case is there a concavity (or more concavities) with an opposed planar surface.

Moreover, the *Livingood et al.* states that "The results of an experimental study of heat transfer characteristics... compare favorably with a similar correlation for the concave surface of a semispherical shell. Such a favorable comparison substantiates the semicylindrical correlation which is used in the design of turbine vanes and blades". The hemispherical design of the surface was selected to investigate the heat characteristics of an impinging jet in the real hemicylindrical design of the working environment. The hemispherical design is clearly defined as an exclusive experimental arrangement for simulating a real semicylindrical surface.

iv. U.S. Patent No. 5,586,866 to Wettstein.

Wettstein discloses to direct a plurality of impingement jets onto the concave surface of the semicylindrical leading-edge of a blade, as shown in Fig. 6. *Wettstein* also discloses a wall to be cooled having an impingement facing side formed as a relief or as a ribbed wall, as shown in Fig. 3 and Fig. 4, respectively. But neither this relief nor the ribbed surfaces form concavities. The wall structure is characterized by a plurality of projecting humps or projecting ribs. For avoiding non-homogeneous heat transfer, the jets are either directed onto the humps (Fig. 3) or the jets are thickened in such a way to hit the projecting ribs (Fig. 4). The thickened jets hit the ribs much more intensively than the distant ground of the channels between them. Therefore, *Wettstein* clearly teaches to force the intensive

cooling into the projecting parts of the wall, where the wall is relatively thick, and to limit the mainly convective cooling to the recessed areas, where the wall is thick.

C. The Examiner's Position

The Examiner's position with respect to the anticipation rejection of Claims 1 and 5-6 under 35 U.S.C. § 102 (b) is that *Cermak* teaches all of the features of the claimed invention, but does not provide any reasoning for such a rejection. Instead, the Examiner points only to Figure 2, with no explanation whatsoever as to how *Cermak* shows each and every feature of the claimed invention.

The Examiners's position with respect to the obviousness rejection of Claims 1-2 and 5-6 under 35 U.S.C. § 103 (a) over *Cermak* in view of *Ashiwake et al.* is that *Cermak* discloses all of the claim limitations except the troughs having a spherical cup form. The Examiner relies on *Ashiwake et al.* for disclosing a heat exchanger comprising a plurality of impingement orifices in carrier 16; and wall parts 8 having a remote planar side and spherical cup impingement side (Figure 8) for the purpose of improving heat transfer. The Examiner alleges that it would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ in *Cermak* troughs having a spherical cup form for the purpose of improving heat transfer as recognized by *Ashiwake et al.*

The Examiners's position with respect to the obviousness rejection of Claims 1-2 and 5-6 under 35 U.S.C. § 103 (a) over *Livingood et al.* in view of *Wettstein et al.* is that *Livingood et al.* discloses cooling a turbine vane or blade by impingement to a concave hemispherical surface, but does not disclose a plurality of impingement jets opposed to a

wall part. *Wettstein et al.* discloses a turbine blade (Figure 6) comprising a wall part 10 having an impingement facing side and opposed planar side, and carrier 13 having a plurality of impingement orifices defined by tubes 11 for the purpose of achieving a desired heat exchange. The Examiner alleges that it would have been obvious at the time the invention was made to a person having ordinary skill in the art to employ in *Livingood et al.* a plurality of impingement orifices defined by tubes for the purpose of achieving a desired heat exchange as recognized by *Wettstein et al.*

IV. ISSUES

The first issue on appeal is whether Claims 1 and 5-6 were properly rejected under 35 U.S.C. § 102(b) as being clearly anticipated by GB 849,255 to *Cermak*.

The second issue on appeal is whether Claims 1, 2, 5, and 6 were properly rejected under 35 U.S.C. § 103(a) as being obvious over *Cermak* in view of U.S. Patent No. 5,365,400 to *Ashiwake et al.*

The third issue on appeal is whether Claims 1-2 and 5-6 were properly rejected under 35 U.S.C. §103(a) as being obvious over the NASA Publication to *Livingood et al.* in view of U.S. Patent No. 5,586,866 to *Wettstein*.

V. GROUPING OF THE CLAIMS

Claims 1 and 5-6 have been grouped together for purposes of the rejection based on 35 U.S.C. § 102(b). It is believed that Claims 1 and 5-6 stand or fall together.

Claims 1-2 and 5-6 have been grouped together for purposes of the rejection based on 35 U.S.C. § 103(a) over *Cermak* in view of *Ashiwake*. It is believed that Claims 1-2 and 5-6 stand or fall together.

Claims 1-2 and 5-6 have been grouped together for purposes of the rejection based on 35 U.S.C. § 103(a) over *Livingood et al.* in view of *Wettstein*. It is believed that Claims 1-2 and 5-6 stand or fall together.

VI. ARGUMENT

A. *Cermak* Does Not Disclose Each and Every Feature of Independent Claim 1

The Examiner seeks to rely on *Cermak* for teaching each and every element of the claimed invention. However, *Cermak* fails to disclose that troughs are in the form of spherical cups, as conceded by the Examiner. *Cermak* also fails to disclose that the troughs are in the form of similar rotationally symmetrical forms. As discussed in the specification, the troughs defined in the present invention provide an advantage over "known elements having areas running perpendicular to the wall". See page 7, lines 7-10 of the present application.

It appears that the Examiner is attempting to equate the cylindrical pockets of *Cermak* with the spherical cups or other similar rotationally symmetrical formed troughs as

defined in independent Claim 1. However, the cylindrical pockets of *Cermak* have side walls that run perpendicular to the wall. For example, Figs. 2 and 3 of *Cermak* disclose a wall with cylindrical pockets. In a sectional view, these pockets have a rectangular shape. This shape forms a sharp edge at the base area with a clearance volume and a constant cross-section for the flow-off of cooling air. This configuration results in unfavorable flow conditions and non-homogeneous effect on the thermally stressed opposite side of the wall, and therefore, an inhomogeneous temperature distribution on that side, and thermal stresses in the wall. In the field of turbomachines, such stresses are highly unwelcome.

These disadvantages are avoided by providing the surface, facing the impingement jets, with a number of troughs in the form of spherical cups or similar rotationally symmetrical forms, with one impingement jet per trough. Such an arrangement optimizes both the flowing conditions on the impingement side and the temperature distribution on the planar opposite side. As such, *Cermak* fails to disclose the patentable features of independent Claim 1.

B. The Combination of *Cermak* with *Ashiwake et al.* is Inappropriate

The Examiner seeks to rely on *Ashiwake et al.* for disclosing that which is missing from *Cermak*. However, the combination of these two references is not appropriate. In particular, *Ashiwake et al.* relates to the cooling of semiconductors. A plurality of tabular fins are laminated via spacers, having a central through-hole for feeding a cooling fluid and radial passageways between the fins for flowing the cooling fluids in a radial direction, thereby cooling the fins. In every case, the cooling fluid flows through a channel having a

spherical curved contour. The reason for the spherical contour is to produce boundary layer instabilities that cause vertical vortices and to intensify the convective cooling within the channel. As such, the Examiner's assertion that *Ashiwake et al.* discloses impingement cooling is simply wrong. In contrast, *Ashiwake et al.* only relates to a convective cooling through curved channels.

In addition, *Cermak* and *Ashiwake et al.* are not from the same field of endeavor, and one having ordinary skill in the art would not be motivated to combine the two references in the manner suggested by the Examiner. In particular, *Cermak* relates to the field of cooling walls of combustion spaces of high thermal stresses, such as combustion chambers, melting chambers and the like. *Ashiwake et al.* relates to the field of cooling of semiconductor chips. These fields are quite different from each other in essential physical parameters, such as temperature, thermal stresses, pressure, mass flows, dimension, materials, and working condition. As such, Applicants submit that one having ordinary skill in the art of combustion chambers would not look to the field of electronic chips for a solution to cooling a wall of combustion spaces. Accordingly, withdrawal of the rejection based on the combination of *Cermak* with *Ashiwake et al.* is respectfully requested.

C. The Combination of *Livingood et al.* With *Wettstein et al.* Does Not Teach the Features of Independent Claim 1

Livingood et al. discloses an experimental arrangement for studying the heat transfer characteristics of a *single* turbulent air jet impinging on the concave surface of a hemispherical shell. The Examiner concedes that it comprises a single shell with a constant

wall thickness (see Figure 1, section A-A). This experiment is a simulation of impingement cooling of the internal surface of turbine vanes or blades in the leading edge region. This region is characterized by a concave shaped inner surface and a similar shaped outer surface with nearly constant wall thickness. And this concave inner shape of the leading edge is simulated by this experiment for investigating the flow conditions in areas shaped in such a way.

Livingood et al. does not mention directing a plurality of impingement jets onto a wall with an impingement facing side having a plurality of concave hemispherical surfaces. Likewise, *Livingood et al.* does not disclose an opposed wall having a plane design.

Nevertheless, the Examiner alleges that "these parameters appear to be selected for convenience in the experiment". However, Applicants submit that this conclusion is incorrect. The parameters selected in the *Livingood et al.* study reflect the real facts in the area of the leading edge. A constant wall thickness is a characteristic feature of the shell of *Livingood et al.* and a constant or near constant wall thickness is the characteristic feature of the leading edge of a vane or blade. Therefore, *Livingood et al.* clearly refers to impingement cooling of concave walls, characterized by constant thickness in all areas of the concavity.

The Examiner also alleges that "the heat transfer surface comprises more than a single concavity opposed to a planar surface of the vane blade". However, Applicants submit that this allegation is likewise incorrect. There is only a single concavity opposed to the region of the leading edge of a blade or vane. Moreover, there is no opposed planar surface in this region. Inside of the blade of the leading edge is formed a semicylinder,

which longitudinally extends from the foot to the tip of the blade. And the outer wall side is shaped either identically to the inner side or similarly with a thickening in the center. But in no case is there a concavity (or more concavities) with an opposed planar surface.

Moreover, the *Livingood et al.* states that "The results of an experimental study of heat transfer characteristics... compare favorably with a similar correlation for the concave surface of a semispherical shell. Such a favorable comparison substantiates the semicylindrical correlation which is used in the design of turbine vanes and blades". Thus, in contrary to the Examiner's position, the wall thickness was not "selected for convenience", but rather the hemispherical design of the surface was selected to investigate the heat characteristics of an impinging jet in the real hemicylindrical design of the working environment. The hemispherical design is clearly defined as an exclusive experimental arrangement for simulating a real semicylindrical surface. Accordingly, the Examiner's reliance on *Livingood et al.* is misplaced.

Nevertheless, the Examiner seeks to rely on *Wettstein* for teaching that which is missing from *Livingood et al.* However, *Wettstein* discloses "... the baffle surface of the wall part 10, to be cooled, is designed as a relief, i.e., to have relieved or recessed areas and projecting areas, the jets striking the projected humps. Consequently the non-homogeneous heat transmission in the baffle jets can be compensated and a homogeneous temperature distribution on the hot side of the wall part is achieved." See col. 3, lines 21-27 of *Wettstein*. Therefore, *Wettstein* explicitly teaches, in that case, the wall is designed as a relief, not to direct the jets into the recessed areas, but onto the humps for homogeneous temperature distribution on the opposite planar side. *Wettstein* fails to

describe a plurality of spherical troughs with one jet per trough.

As heat transfer is a function of wall thickness, there is a danger of inhomogeneous temperature distribution on the opposed side of the wall. Particularly in modern turbo machines, such as a gas turbine, inhomogeneous temperature distribution is highly unwelcome. Therefore, one having ordinary skill in the art would direct the impingement jets to the areas with the largest wall thickness, and consequently a lower heat transfer, such as the webs of a relief. One having ordinary skill in the art would NOT direct the impingement jets into the deepenings, the point with the smallest wall thickness, and therefore highest heat transfer. *Wettstein* teaches away from directing the impingement jets into the reliefs. Accordingly, *Livingood et al.* is not properly combinable with *Wettstein*. Therefore, neither *Livingood et al.*, nor *Wettstein*, in combination or alone, teach the features of Claim 1.

It appears that the Examiner has viewed the instant application as a guide for modifying the cited art. However, it is well established that the use of the application under examination as a guide to modifying the cited art constitutes impermissible hindsight, and may not be used in rejection of the claims. *In re Bond*, 15 USPQ2d 1566 (Fed. Cir. 1990). Accordingly, the Examiner has failed to establish a *prima facie* case of obviousness.

VII. CONCLUSION

For at least the reasons set forth above, it is respectfully submitted that the rejections of Claims 1-2 and 5-6 are improper and should be reversed.

Respectfully submitted,

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APPENDIX A

The Appealed Claims

1. An impingement flow for a wall part, in which a plurality of impingement orifices are arranged areally in a plane or curved carrier, the carrier being arranged at a distance from the wall part, and an impingement area, to be cooled or heated, of the wall part being designed as a relief, wherein

- that side of the wall part which faces the impingement jet is provided with a number of troughs arranged next to one another, said troughs being in the form of spherical cups or similar rotationally symmetrical forms, one impingement jet per trough being provided, which impingement jet strikes a trough base at least approximately perpendicularly, and

- that side of the wall part which is remote from the impingement jet is of at least roughly plane design.

2. The impingement flow as claimed in claim 1, wherein the trough has the shape of a circle segment.

5. The impingement flow as claimed in claim 1, wherein the wall part to be cooled or heated is made together with the troughs.

6. The impingement flow as claimed in claim 1, wherein the impingement orifices form the inlet of impingement tubes, a mouth of which is directed toward the wall part to be cooled or heated.